



31 January 2024

ASX:14D

## December 2023 Quarterly Activity Report

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### Highlights:

- Successful test of SiBox Demonstration Module in National Energy Market conditions
- Exclusive agreement to commercialise University of Adelaide reactor for hydrogen production
- Technology collaboration to develop SiPHyR, a hydrogen production technology using SiBrick
- Aurora battery connection approval on track for mid 2024

**1414 Degrees Ltd** ("1414 Degrees" the "Company") is pleased to release its Quarterly Report for the period ending 31 December 2023.

### Chairman's Letter

Our SiBox Demonstration Module (SDM) achieved outstanding performance in this quarter, supplying hot air flow at stable temperatures (700-900°C) and maintaining constant discharge for up to 15 hours. Notably the SDM successfully adapted to follow the National Electricity Market (NEM) maintaining constant temperature output even while charging under fluctuating solar and wind energy inputs (Figure 1) and irrespective of internal storage temperature variations. This highlights the independent charge and discharge ability of SiBox technology and demonstrates its robustness and ability to offer a reliable and cost-effective replacement for gas or fossil fuel burning in industrial processes.

Responding to industry requests, we are now testing the SDM's ability to provide Frequency Control Ancillary Services (FCAS) in the NEM. This will involve instantaneous responses to market signals, turning on or off and helping to stabilise the volatile electricity grid without compromising heat energy output. Future SiBox installations will be very much larger and therefore able to provide significant FCAS earnings to reduce the cost of energy for customers.

Your Company's ongoing analysis as part of our continuous research and innovation reviews reveals a positive economic case with substantial emissions reduction when using SiBox for industrial heating, though significant barriers to widespread adoption remain. The substantial electric power required to replace gas in industrial heating is often limited by transmission capacity. Even where enough power is available, transmission or distribution supply charges greatly impact the economics. It is likely that policy will change to mitigate these obstacles to thermal energy storage, as has occurred with batteries, particularly as the benefits are demonstrated.

We have also been developing an hydrogen business model that leverages existing natural gas energy supply to a site without creating carbon emissions. Commercial hydrogen production from methane leads to significant emissions. Electrolysis using water and electricity has lower emissions but requires a very large amount of electricity which is not available at most industrial sites and the resulting hydrogen would be costly.

Your Company is planning to use an alternative low-carbon hydrogen production method, methane pyrolysis, a process that uses a catalyst at high temperatures to produce hydrogen and nearly pure carbon while

requiring only 15% of the electricity used in electrolysis. Additionally, the carbon co-product has commercial applications in many industries. Pyrolysis produces less energy than burning the natural gas, nevertheless, we have calculated that methane pyrolysis could have a compelling business case if it is integrated with our thermal storage media, SiBrick. It is worth noting hydrogen is more efficient than gas in many production processes, with direct reduction iron as one example.

To further this methane pyrolysis model, and as recently announced, your Company has secured the exclusive license to commercialise a University of Adelaide (UoA) fluid reactor design, which we will integrate with SiBrick and SiBox technology to create SiPHyR (SiBrick Integrated Pyrolytic Hydrogen Reactor). The innovative, patent-pending UoA reactor uses a catalytic bubble column to dissociate methane into hydrogen and solid carbon while the integrated thermal storage minimises thermal losses, reduces the cost of input electricity, increases reactor utilisation and most importantly, lets the reactor function at steady state – resulting in higher efficiency.

We are in a market that is of great importance for future global sustainability goals, and we have products that can make a large commercial impact, as such we want to tell our story to wider investor and commercial communities. Your team are engaging in a series of presentations to prospective investors and commercial technology partners internationally. If you are interested in a shareholder meeting, please send an email to our investor relations email address. I look forward to reporting on a productive next quarter for shareholders.



Dr Kevin Moriarty  
Executive Chairman

### Commercialisation Report

Multiple industry case studies were completed for SiBox integrating with high temperature industrial processes, replacing natural gas as the heat source. These studies include Direct Reduced Iron (DRI), Bayer's alumina (steam circuit and calcination), steam methane reforming for hydrogen production, electrical grid support, and cement.

We are also developing a business model utilising the energy in existing natural gas supply to a site to make low-emission hydrogen with methane pyrolysis. Integrating SiBrick and SiBox thermal storage with pyrolysis provides efficiency gains and reduces electricity costs. Hydrogen can significantly improve efficiency in many processes, thereby requiring less energy, while reducing emissions and carbon capture costs. Central to this commercial strategy is the new SiPHyR technology under development by 1414 Degrees and collaborators.

SiBox®

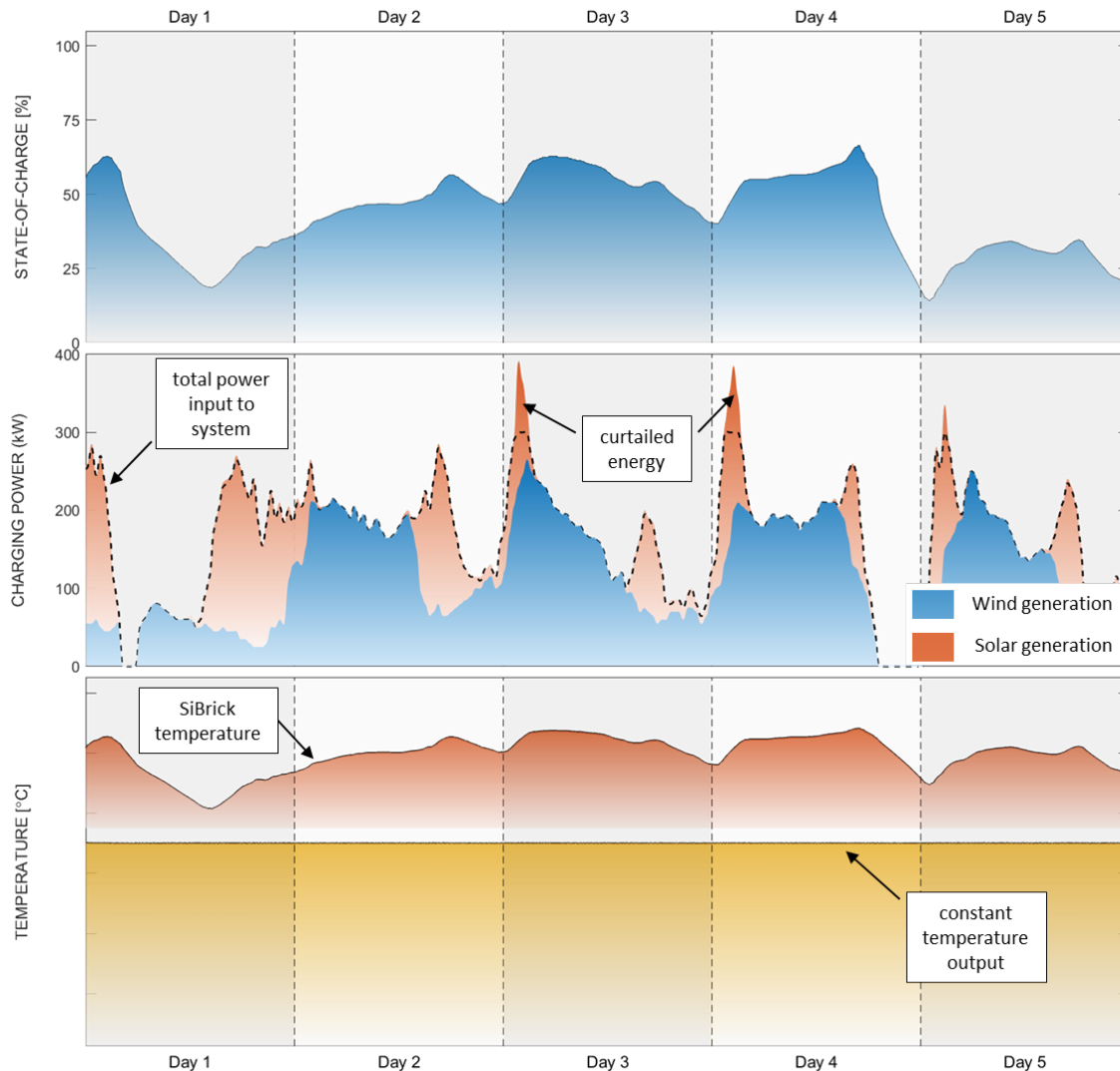


Figure 1 shows the SDM maintaining constant temperature output for 5 days from a variable wind and solar supply over 5-days of continuous generation data from SA NEM.

Operational testing of the SiBox Demonstration Module is producing excellent results. Key outcomes to date are:

- Completed 184 latent heat cycles (92% progress to target of 200 cycles)
- Successfully demonstration of multiple Simultaneous Charge and Discharge operations (SIMOPS) maintaining a constant heat output over a week continuously for each test. The heating system charged the storage as required when wholesale energy prices were low to maintain storage capacity. Also completed a variant of this test where the heating input was matched to a simulated solar PV and wind generation capacity profile.
- A nominal 850°C charge-discharge cycle was conducted to benchmark performance following 6 months of testing. The system showed no significant variation of performance, indicating that the storage media is robust.

### SiBrick®

The development program for 1414 Degrees' proprietary thermal storage media, SiBrick, is progressing towards a design that is both durable for long term use and suitable for mass production. The first batch of this newly designed SiBrick is currently being produced in Germany by our technology partner, Refratechnik-Steel GmbH, who will then conduct thorough thermal cycling and analysis of the storage media.

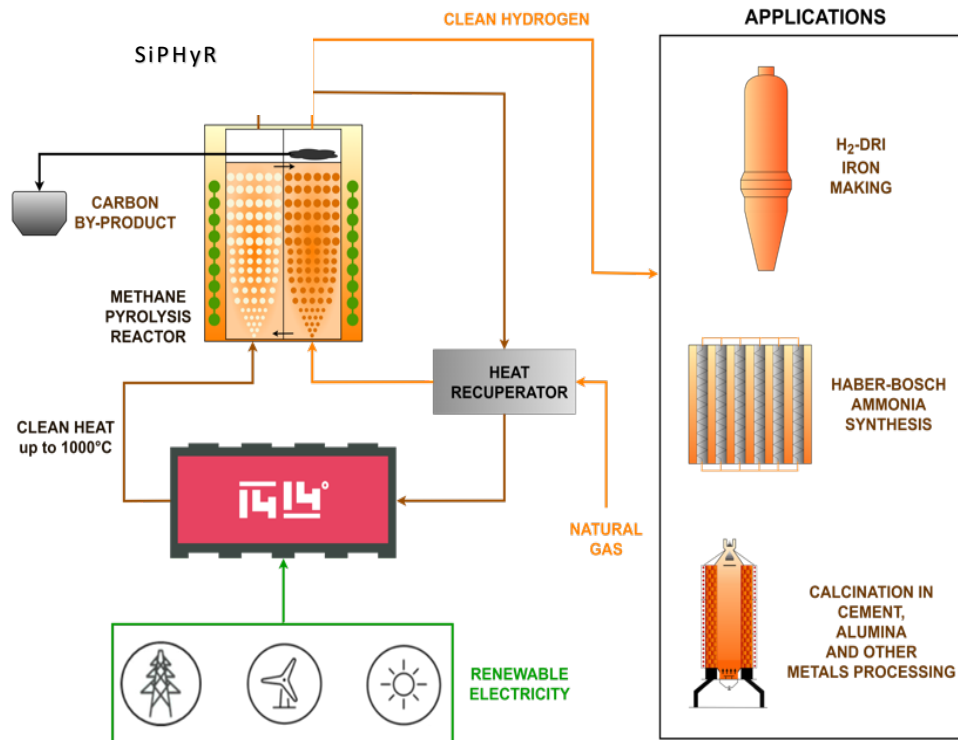
Following this phase, a trial for the mass production of SiBrick will commence. This trial will involve producing a large batch of SiBrick which will then undergo a rigorous three-month testing campaign. This testing will take place under active airflow conditions in our original 2016 prototype, which is currently undergoing refurbishment. The primary objective of these tests is to validate the durability and robustness of the storage media, while in future SiBrick iterations the focus will shift towards producing a lower cost brick.

### SiPHyR

SiPHyR combines methane pyrolysis - a high-temperature process that transforms methane into hydrogen gas and solid carbon, with 14D's proprietary silicon energy storage technologies SiBrick® and SiBox®. SiPHyR stands out in the lower-emissions hydrogen production landscape by circumventing the technical and cost challenges of capturing carbon dioxide from hydrogen produced via gas reforming, while requiring less electricity generation and transmission infrastructure than hydrogen produced via water electrolysis using renewable power.

Your Company has an exclusive license to commercialise the University of Adelaide's dual column bubble reactor and is preparing to do this by integrating the stable heat supply from SiBox and SiBrick to achieve,

Figure 2 Illustration of how SiPHyR reactor could integrate with some heavy industries.



continuous and separate production of nearly pure carbon and hydrogen. Several countries are moving to create a major favourable trading environment for hydrogen produced with low emissions<sup>1</sup>.

We will progress the SiPHyR project to produce a prototype that can then be scaled up for commercial production of hydrogen and carbon. The total global low-carbon hydrogen production is anticipated to reach ~25 Mtpa in the next decade, and SiPHyR deployment can potentially reach its critical mass of some 1000 tpa scale in that timeframe and produce hydrogen for less than \$2/kg.

A significant advancement of SiPHyR technology could enable the widespread uptake of sustainable hydrogen in heavy industries by greatly reducing the cost of production and emissions. When fully developed and commercialised, SiPHyR could be retrofitted into heavy industry without major process modifications or disruptions. This technology has significantly lower energy requirements compared to other hydrogen production routes; deployment at scale will incur much lower transmission energy infrastructure costs and hence a faster path to commercialisation. Figure 2 on the previous page illustrates how the reactor could be applied to some heavy industries.

There are also commercial applications for the SiPHyR carbon co-product, such as feedstock for dye/ink and electrodes, or additives in concrete, tyres, and composites.

### **Aurora Energy Precinct**

SiliconAurora Pty Ltd (50:50 14D:Vast Solar) is continuing to advance the Aurora Energy Precinct. BHP are engaged in finalising an agreement to open access to the 275kV line for the Precinct. The Transmission Connection Agreement (TCA) for the two-hour 140MW Battery Energy Storage System (BESS) is underway following submission to the transmission provider Electranet in the previous quarter. The BESS and other Precinct projects have Development and Native Vegetation approvals from the South Australian Government. The terms of a Tripartite land agreement between the SA Government, SiliconAurora Pty Ltd and the previous Crown lessee is expected to be executed in the current quarter. There is in-principle agreement with ARTC for access over the rail line. The Precinct land holding operates under a 40-year Crown Lease and land access agreements are in place.

### **Corporate and Financial**

14D is currently evaluating various options to strengthen its capital position to ensure adequate funding for commercialising its technologies and realising shareholder value. These options include considering the partial sale of the near mature BESS project as well as partnerships for our technology deployment within industry. As previously announced mid-year, we have engaged London-based investment bank Hannam & Partners to aid in this process. They are currently coordinating briefings for corporate investors and facilitating introductions to synergistic technology companies.

The share market responded very positively to the announcement that Woodside had increased its grant for SiBox development to \$2.75m. This followed shareholders contributing near \$1.5m for technology development in the successful rights issue in the previous quarter. The broker mandate to place the shortfall

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<sup>1</sup> <https://www.afr.com/companies/energy/germany-s-660m-pitch-for-australia-s-green-hydrogen-20240118-p5ey7m>



expired before the share price uplift, and no further shares were placed at 4.5 cents with 10 cent attaching options.

Due to the advanced state of our technology commercialisation your Company is eligible for grant funding and several applications are in process. We anticipate receiving \$1.47m as a research and development rebate early in the current quarter.

Your Company ended the quarter with \$1.442 million in cash, a decrease of \$626,000 from the previous quarter. As required by ASX Listing Rule 4.7C3, the Company notes that \$66,000 was paid to related parties during the quarter. These payments were Directors Fees.

#### **AUTHORISED BY:**

Dr Kevin Moriarty, Executive Chairman on behalf of the Board of Directors

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#### **ABOUT 1414 DEGREES LIMITED**

1414 Degrees is an innovative clean energy company specialising in thermal energy storage solutions to decarbonise high temperature industry and power generation. 1414 Degrees' SiBrick® is a mass manufacturable silicon thermal storage which harnesses silicon's extremely high energy density. The SiBox® latent heat battery, one of several applications for SiBrick, provides consistent, carbon-free heat at high temperatures from renewable sources.

In 2019 the Company made the strategic purchase of the Aurora Energy Precinct (AEP) located near Port Augusta, South Australia. AEP is a long-term renewable energy initiative to deliver reliable electricity to the region and National Electricity Market. The precinct has approval for 14D to pilot and demonstrate a large commercial scale version of the SiBox technology.

For more information, please visit [www.1414degrees.com.au](http://www.1414degrees.com.au)

#### **Forward-looking statements**

This announcement includes forward-looking statements which may be identified by words such as 'anticipates', 'believes', 'expects', 'intends', 'may', 'will', 'could', or 'should' and other similar words that involve risks and uncertainties. These forward-looking statements are based on the 1414 Degrees' expectations and beliefs concerning future events as at the date of this announcement. Forward-looking statements are necessarily subject to risks, uncertainties and other factors, many of which are outside the control of 1414 Degrees, which could cause actual results to differ materially from such statements. 1414 Degrees makes no undertaking to update or revise the forward-looking statements made in this announcement to reflect any change in circumstances or events after the date of this announcement.

For more information, please visit [www.1414degrees.com.au](http://www.1414degrees.com.au)